

REMARKS

Applicants respectfully request reconsideration of the present application in view of the foregoing amendments and in view of the reasons which follow.

Claims 1-5, 20, and 22 are amended. After amending the claims as set forth above, claims 1-23 are now pending in this application.

Rejections Under 35 U.S.C. § 112

In Section 2 of the Office Action, claims 4 and 5 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. By this amendment, "resistance" in claims 4 and 5 is amended to be "resistivity." Applicants respectfully request withdrawal of the rejection.

In Section 3 of the Office Action, claim 22 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. By this amendment, "staffed" in claim 22 is amended to be "stuffed." Applicants respectfully request withdrawal of the rejection.

Rejections under 35 U.S.C. § 103

Rejections of Claims 1-9

In Sections 5-7, claims 1-3 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6, 399,496 (Edelstein et al.) in view of U.S. Patent No. 6,090,710 (Andricacos et al.), U.S. Patent No. 5,004,520 (Tsuji et al.), and U.S. Patent App. 2002/0039542 (Bogel et al.). Applicants respectfully traverse the rejection. Edelstein et al., Andricacos et al., Tsuji et al., and Bogel et al. (alone or in combination) do not describe, suggest, or teach the claimed invention as recited in claims 1-3.

In Section 8 of the Office Action, claims 4 and 5 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein et al. in view of Andricacos et al., Tsuji et al., and Bogel et al. Applicants respectfully traverse the rejection. Edelstein et al., Andricacos et al., Tsuji et al., and Bogel et al. (alone or in combination) do not describe, suggest, or teach the claimed invention as recited in claims 4 and 5.

In Section 9 of the Office Action, claims 6-9 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein et al. in view of Andricacos et al., Tsuji et al. and Bogel et al. and further in view of Semiconductor International, April 2000, pp.1-8 (Cunningham) and U.S. Patent No. 5,243,222 (Harper et al.). Applicants respectfully traverse the rejection. Edelstein et al., Andricacos et al., Tsuji et al., Bogel et al., Cunningham, and Harper et al., (alone or in combination) do not describe, suggest, or teach the claimed invention as recited in claims 6-9.

Amended claim 1 recites:

depositing a ternary copper alloy via material in the via aperture to form a via

Claims 2-9 depend from claim 1 and, thus, require all of the limitations of claim 1, including this one.

Edelstein et al. describes the use of a seed layer. Using a seed layer with a conductive layer is different than depositing a ternary copper alloy via material. Edelstein et al. does not disclose or suggest depositing a ternary copper alloy via material. Moreover, **there is no suggestion in the other cited references** (Andricacos et al., Tsuji et al., Bogel et al., Cunningham, and Harper et al.) **to modify Edelstein et al. such that it not deposit a seed layer, but instead deposit a ternary copper alloy via material to form a copper alloy via.** The claim limitation “depositing a ternary copper alloy via material in the via aperture to form a via” is recited by claims 1-9.

A proper rejection must include references that disclose, suggest, or teach **all** of the limitations recited in the claim. Here, there is no suggestion or teaching of depositing a ternary copper alloy via material to form a via. Accordingly, Applicants respectfully request withdrawal of the rejections, as outlined in Sections 5-9 of the Office Action.

Rejections of Claims 10-16

In Section 10 of the Office Action, claim 10 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein et al. in view of Cunningham. Applicants respectfully traverse the rejection. Edelstein et al. and Cunningham (alone or in

combination) do not describe, suggest, or teach the claimed invention as recited in claim 10.

In Section 11 of the Office Action, claims 11-13 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein et al. in view of Cunningham and further in view of Andricacos et al. Applicants respectfully traverse the rejection. Edelstein et al., Cunningham, and Andricacos et al. (alone or in combination) do not describe, suggest, or teach the claimed invention as recited in claims 11-13.

In Section 12 of the Office Action, claims 14-16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein et al. in view of Cunningham and further in view of Harper et al. Applicants respectfully traverse the rejection. Edelstein et al., Cunningham, and Harper et al. (alone or in combination) do not describe, suggest, or teach the claimed invention as recited in claims 14-16.

Claim 10 recites:

filling the via aperture with a ternary copper alloy via material to form a ternary copper alloy via.

Claims 11-16 depend from claim 10 and, thus, require this same limitation.

As was discussed above with respect to the rejections of claims 1-9, Edelstein et al. does not suggest or teach filling a via aperture with a ternary copper alloy via material. The Figures and text of Edelstein et al. teach depositing a **seed layer** over the barrier layer. Seed layer 76 (Fig.2) and seed layer 78 (Fig. 3B) of Edelstein et al. are deposited over the barrier layer but do **not** fill the aperture. Copper layers 60 and 56 (Fig.2) and conductive layer 82 (Fig. 3C) of Edelstein et al. do not have an alloy and there is no suggestion of using a copper alloy via material to fill the via.

Cunningham discusses use of dopants. There is no suggestion or teaching in Cunningham that a ternary copper alloy material is used to fill a via. Indeed, Cunningham on page 7 suggests sputtering or electroplating the dopants, or plating cadmium/copper or zinc/copper simultaneously, but not using a ternary copper alloy via material.

Neither Edelstein et al. nor Cunningham suggest or teach “filling the via aperture with a ternary copper alloy via material to form a ternary copper alloy via” as recited by claims 10-16. As such, the rejections cannot be properly maintained. Applicants respectfully request withdrawal of the rejections, as outlined in Sections 10-12 of the Office Action.

Rejections of Claims 17-20

In Section 13 of the Office Action, claims 17-20 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein et al. Applicants respectfully traverse the rejection. Edelstein et al. does not disclose, suggest, or teach the claimed invention as recited in claims 17-20.

Claim 17 recites:

filling the aperture with a ternary copper alloy via material
to form a ternary copper alloy via

Claims 18-20 depend from claim 17 and, thus, require this same limitation.

As discussed above, Edelstein et al. does not suggest or teach filling the aperture with a ternary copper alloy via material. The Figures and text of Edelstein et al. teach depositing a ***seed layer*** over the barrier layer where the seed layer and barrier layer are in the via aperture, but do not fill it and do not form a ternary copper alloy via.

Accordingly, Applicants respectfully request the withdrawal of the rejection of claims 17-20. Edelstein et al. fails to disclose, suggest, or teach the limitations of these claims. Specifically, there is no suggestion in Edelstein et al. of using a copper alloy via material to fill the via aperture.

Rejections of Claims 21-23

In Section 18 of the Office Action, claims 21 and 23 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein et al. as applied to claims 17-20 above, and further in view of Cunningham. Applicants respectfully traverse the

rejection. Edelstein et al. and Cunningham (alone or in combination) do not describe, suggest, or teach the claimed invention as recited in claims 21 and 23.

In Section 19 of the Office Action, claim 22, in so far as being in compliance with 35 U.S.C. § 112, is rejected under 35 U.S.C. § 103(a) as being unpatentable over Edelstein et al., as applied to claims 17-20 above, and further in view of Cunningham. Applicants respectfully traverse the rejection. Edelstein et al. and Cunningham (alone or in combination) do not describe, suggest, or teach the claimed invention as recited in claim 22.

As explained above with respect to claims 17, Edelstein et al. fails to disclose or suggest "filling the aperture with a ternary copper alloy via material to form a ternary copper alloy via" as recited by claim 17. Claims 21-23 depend from 17.

Cunningham discusses use of dopants. There is no suggestion or teaching in Cunningham that a ternary copper alloy material be used to fill a via aperture and form a copper alloy via. Indeed, Cunningham on page 7 suggests sputtering or electroplating the dopants, or plating cadmium/copper or zinc/copper simultaneously. Neither Edelstein et al. nor Cunningham suggest or teach "filling the aperture with a ternary copper alloy via material to form a ternary copper alloy via" as recited by claims 21-23. As such, the rejections cannot be properly maintained. Applicants respectfully request withdrawal of the rejections, as outlined in Sections 18 and 19 of the Office Action.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 06-1447. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated,

otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 06-1447. If any extensions of time are needed for timely acceptance of papers submitted herewith, applicant hereby petitions for such extensions under 37 C.F.R. § 1.136 and authorizes payment of any such extensions fees to Deposit Account No. 06-1447.

Respectfully submitted,

Date May 13, 2003

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